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Geoscientific
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Discussions

Interactive comment on "The ICON-1.2 hydrostatic atmospheric dynamical core on triangular grids – Part 1: Formulation and performance of the baseline version" *by* H. Wan et al.

Anonymous Referee #1

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Dear authors,

I appreciate very much the effort to describe the approach used by ICON. My comment are mostly of editorial character.

1. The introductory part, as written, lacks in reality motivation and mixes several things together. It is true, that mass conservation is desirable, but one can do it with spectral methods too (the other question is whether this is practical). Further, mass conservation is intrinsic in many existing finite-volume or finite-element solutions, so why a new development? Then, one learn about pole singularity, then about the need for local zooming, and the need of developing atmosphere and ocean in the same framework

(but it is not explained what is implied here). I think that the goals should be formulated more precisely, and given the goals, the approach followed by ICON should be motivated. Also, this should be done, perhaps, not solely on the background of spectral models, but many other efforts that have already implemented icosahedral approaches (beginning from GME to MPAS).

2. This eventually leads us to the question of why triangular C-grid is selected instead of hexagonal C-grid. Using an approach with a too large scalar space is far from being the accepted way to go.

3. I like the explanation of divergence noise proposed in the manuscript, but would like to comment that the velocity field the model operates with is the discrete field produced by model numerics. While the explanation highlights the origin, it not necessarily gives the correct estimate in the end.

4. The proposed magnitude of biharmonic diffusivity (scaled with time step) would effectively imply more dissipation as the resolution is refined. I do not think it is justifiable. Also it basically implies that flows at grid scale are experiencing e-fold damping per time step.

Minor comments Abstract: "and show a clear trend of convergence as the horizontal resolution increases" Did you have any doubts? Is it an achievement a reader should learn about?

Introduction: "adiabatic fluid dynamics equations that govern the atmospheric motions" — there always are sources and sinks

"to avoid the polar singularities of global latitude-longitude grids" — true, but how it is related to the motivation above?

The main text: Fig. 1 p and phi are appearing at full and half levels

"For example the divergence operator per construction makes it straightforward to achieve mass conservation", — but it is so in any finite volume or finite elements, so what is the point?

"The divergence and gradient operators are mimetic in the sense that the rule of integration by parts has a counterpart in the discrete model (cf. Eqns. (9) and (10) in BR05), a desirable property for achieving conservation properties. — again it is maintained by each properly designed model — there is no way in obtaining correct transfers between the kinetic and available potential energy if this consistency is violated.

section 4.3: grid scale noise is seen in p_s when it is too late. It is typically seen in the horizontal divergence and leads to problems very gradually.

"vector Laplacian (15)" — vector biharmonic operator

What is the advantage of RBFs over the Perot reconstruction?.

Fig. 6 Is the left panel for day 6 correct?

"The simulated flow does not appear noisy (cf., e.g., Fig. 9)." — This should be judged by looking at the horizontal divergence or 'vertical velocity'

Interactive comment on Geosci. Model Dev. Discuss., 6, 59, 2013.